

# Processing Multitemporal TM Imagery to Extract Forest Cover Change Features in Cleveland National Forest, Southern California

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Sacramento

Dar Roberts: UC Santa Barbara



# Introduction and Background

- \* Forest cover change mapping

- \* Research Question:

Can **M**ultitemporal **S**pectral **M**ixture  
**A**nalysis techniques be effectively used to  
accurately map forest cover changes in  
southern California?

- \* Specifically:

- What categories of forest cover  
change can be mapped using MSMA  
techniques?

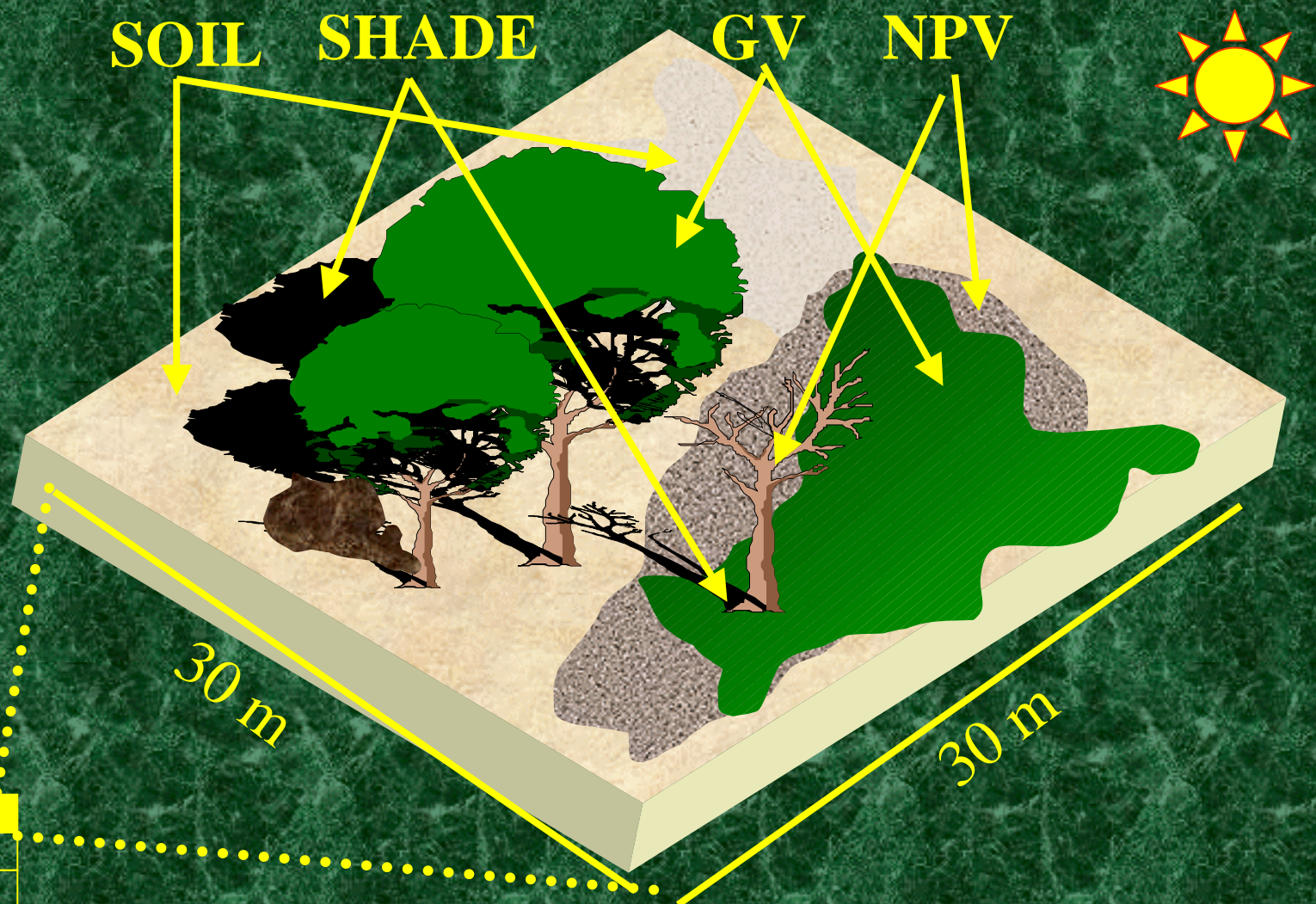


# Vegetation Disturbance



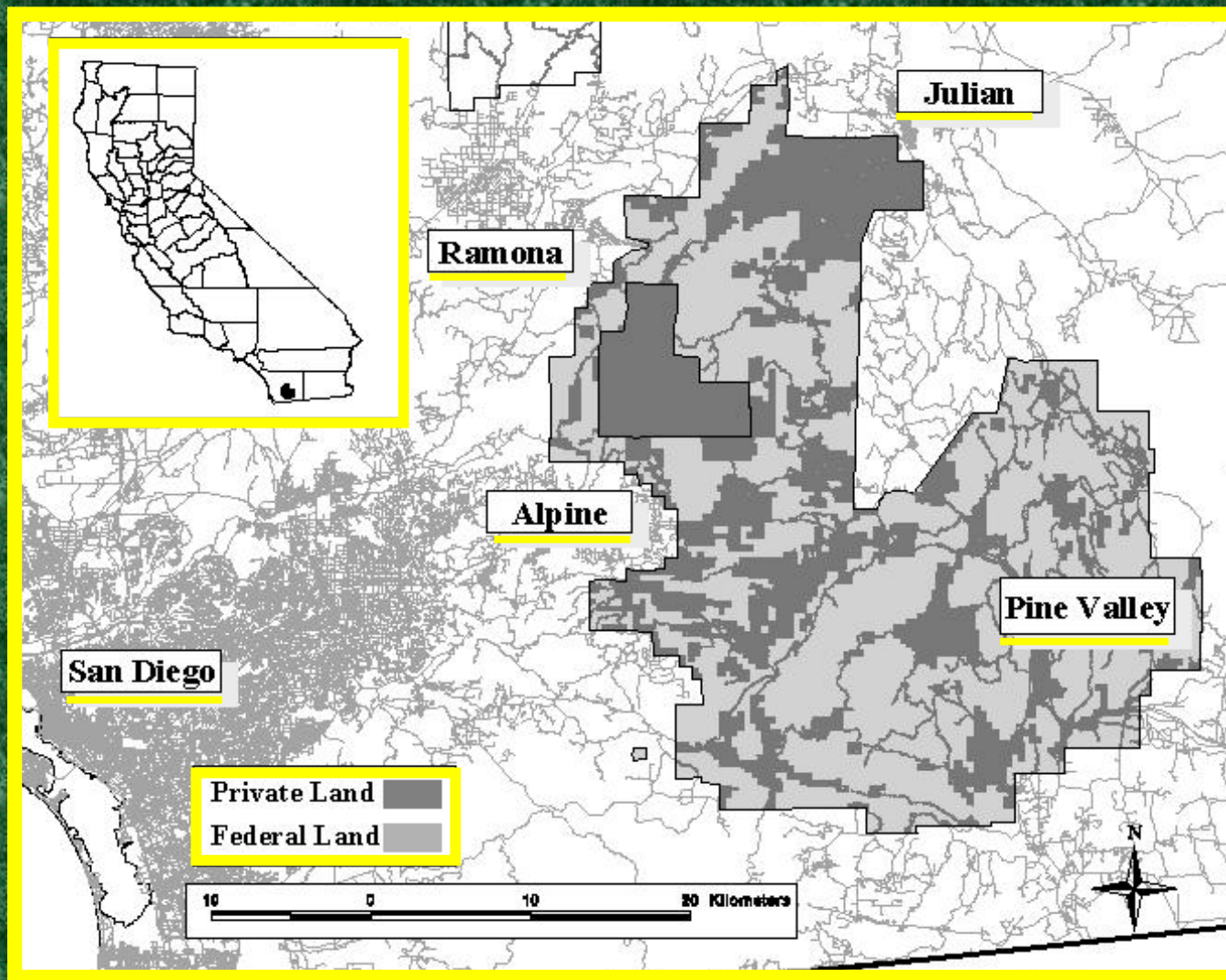


# Conceptual Schema of Spectral Mixture Model





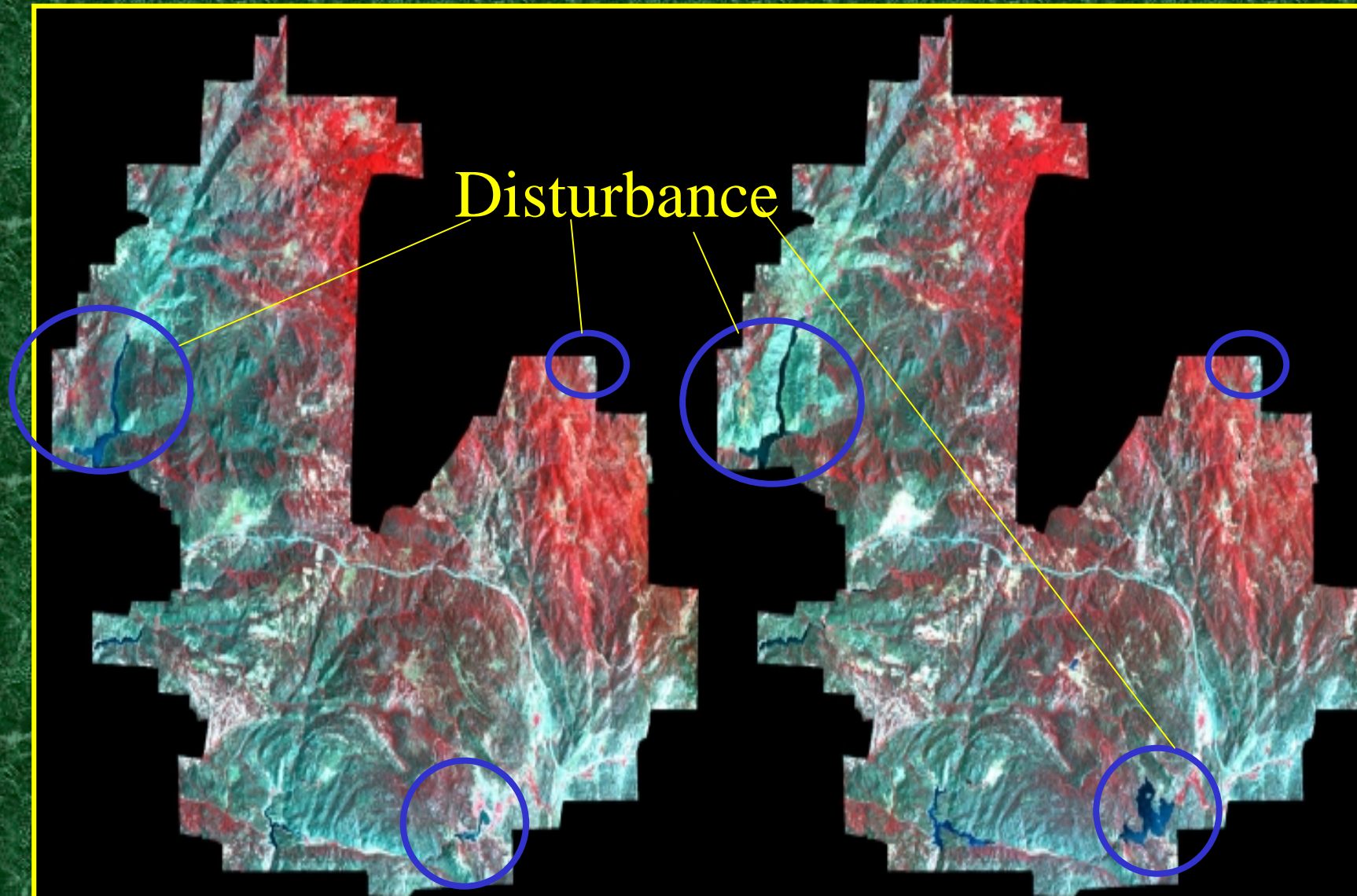
# Study Site





Descanso: June 1990

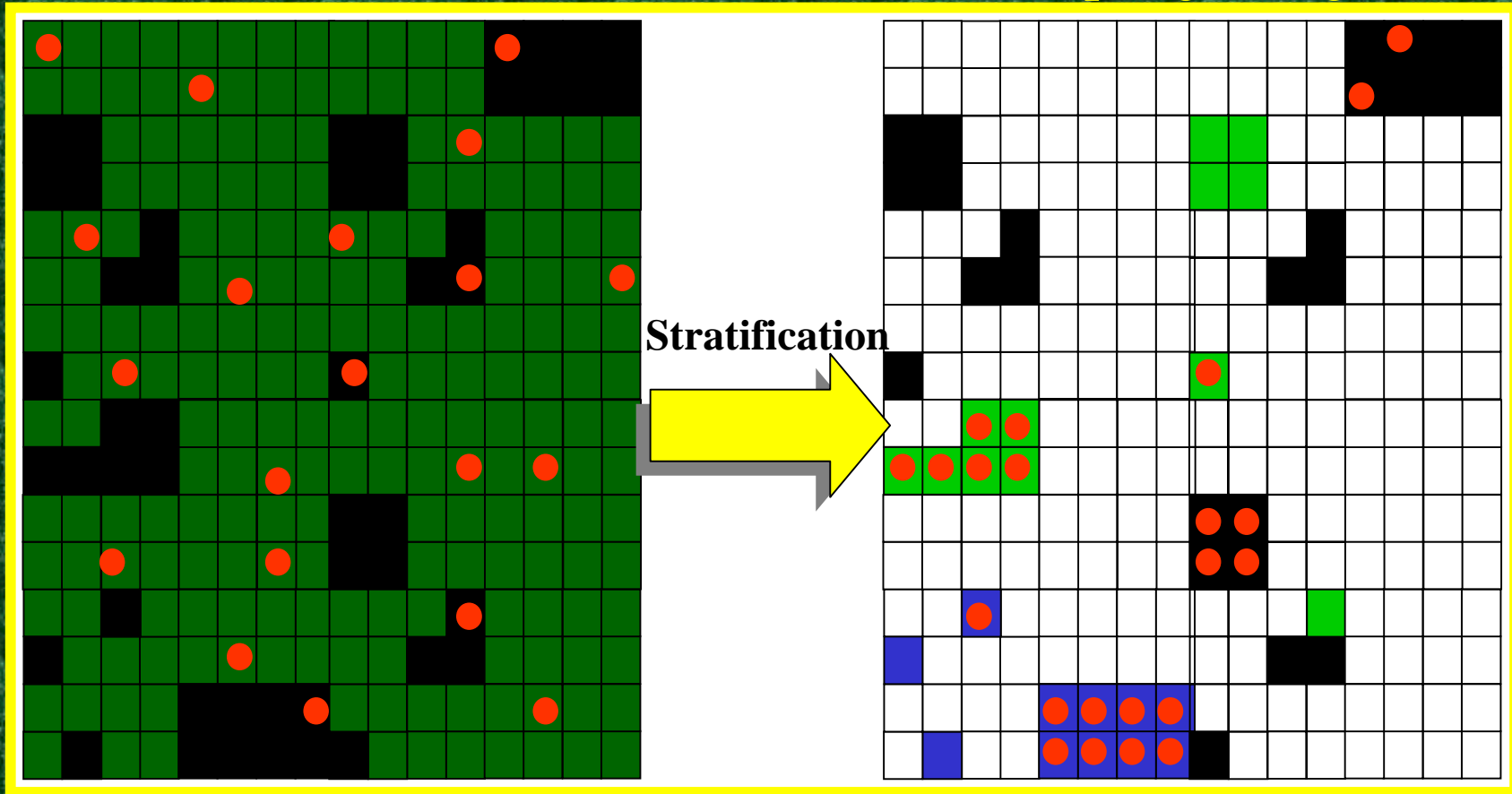
Descanso: June 1996



# Field Sampling Protocol

Random Sampling Design

Stratified Adaptive Cluster Sampling Design



Change No Change  
Sample Plot

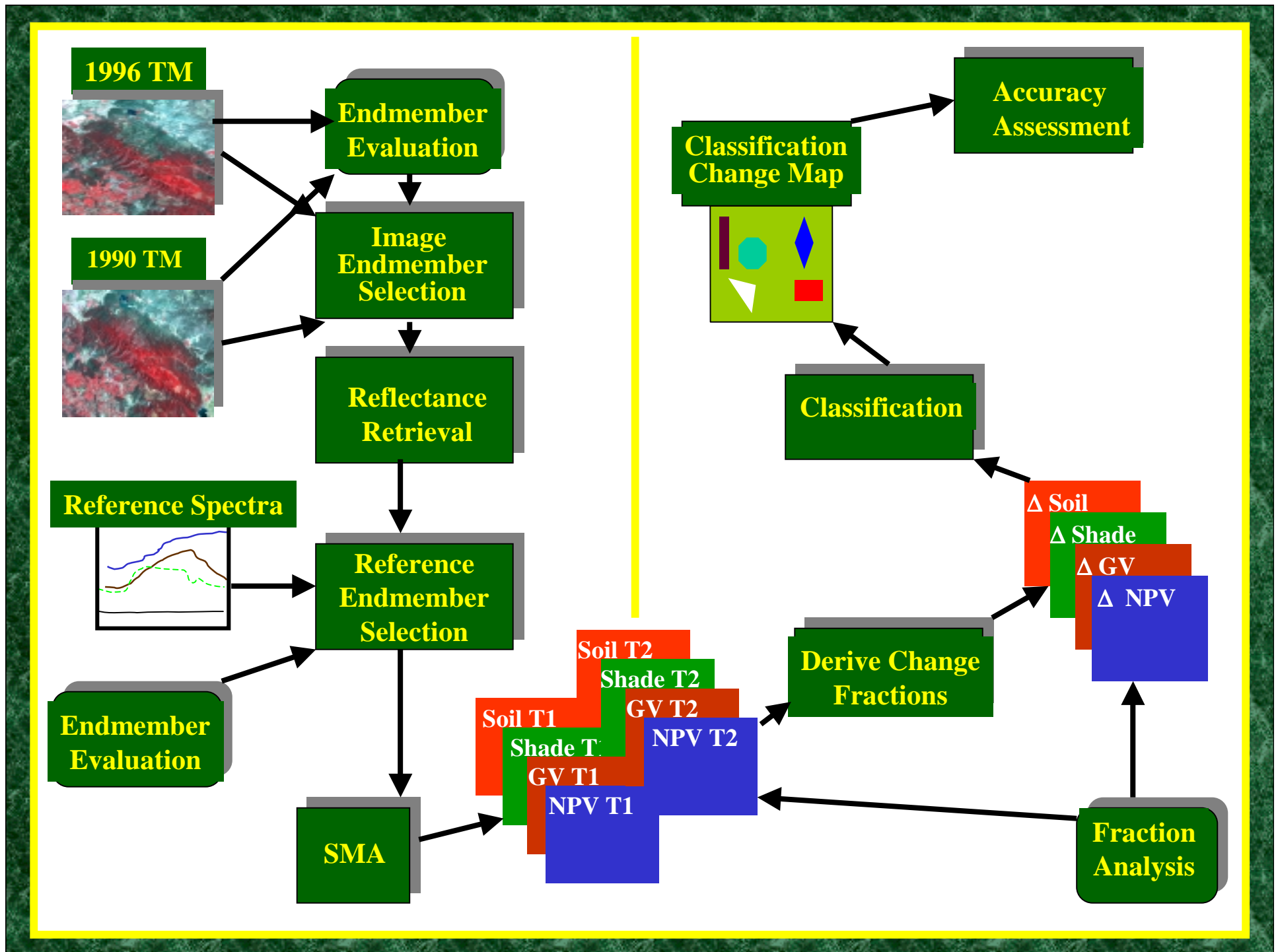
Change 1 Change 2 Change 3  
Sample Plot



# Methods

- Data Preprocessing
  - Radiometric normalization and Absolute atmospheric correction
- Spectral Mixture Analysis
  - Endmember selection: Image Vs Reference
  - Spectral Unmixing: Shade, Soil, GV, NPV and RMS
- Image-differencing
- Classification: Maximum Likelihood Vs Decision Tree
- Accuracy Assessment: Contingency Matrix







FOREST CHANGE CLASS	FRACTION CHARACTERISTICS AND DYNAMICS
NO CHANGE	Consistent shade, soil, NPV and GV fractions over time
VEGETATION INCREASE	<i>Increase</i> in GV and possible increase in shade in vegetation due to plant-architectural shade <i>Decrease</i> in Soil and NPV over time due to increased ground cover by vegetation
VEGETATION DECREASE	<i>Decrease</i> in GV and plant-architectural Shade <i>Increase</i> Soil and NPV due to decreased vegetation ground cover over time
CHANGE IN NON- VEGETATED AREAS	<i>Decrease</i> in GV due to land clearing and construction <i>Increase</i> in Shade, Soil and, possibly NPV



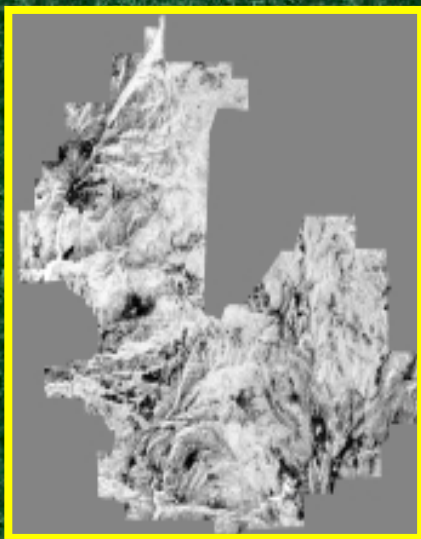
# Endmembers used to Model 90-96 Scenes



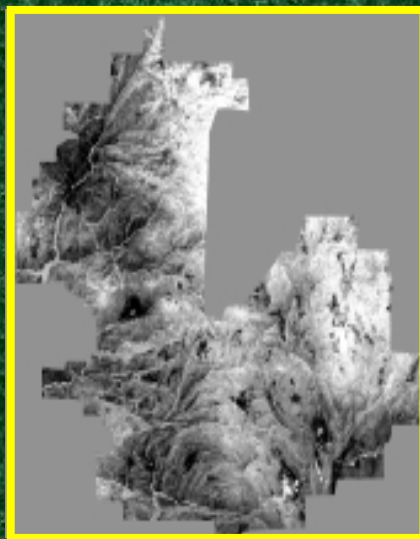


# 1990 Fractions

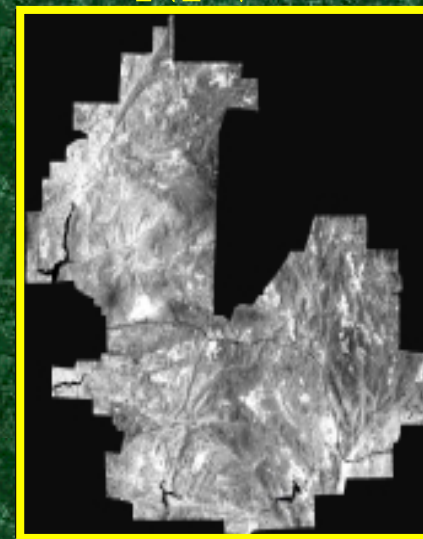
Shade



GV



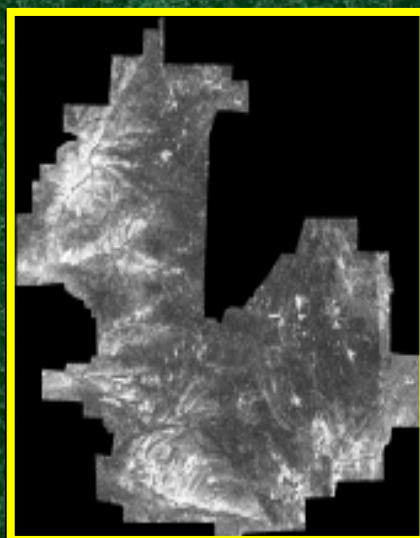
NPV



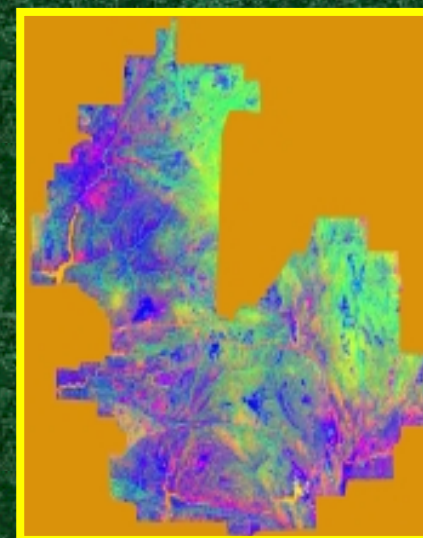
Soil



RMS



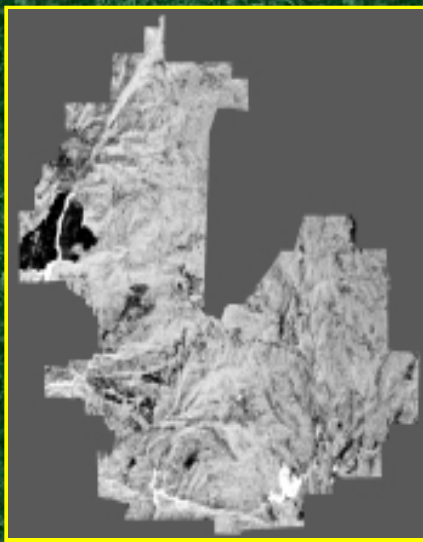
RGB: Soil, GV, NPV



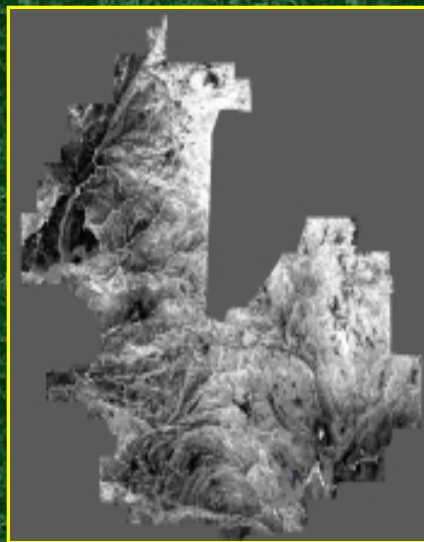


# 1996 Fractions

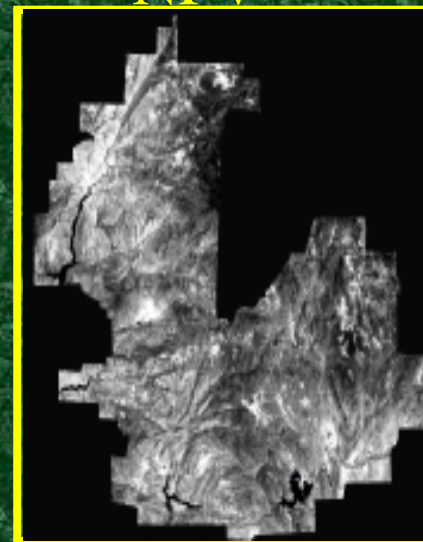
Shade



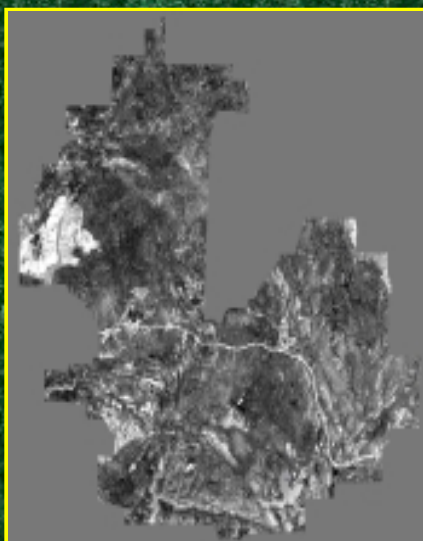
GV



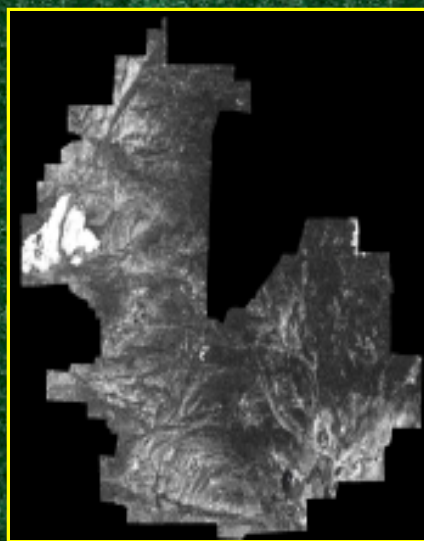
NPV



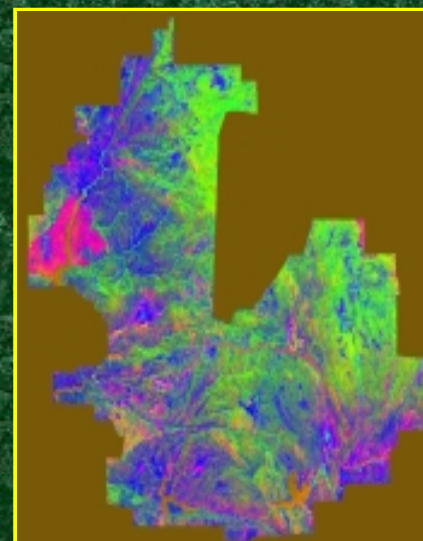
Soil



RMS



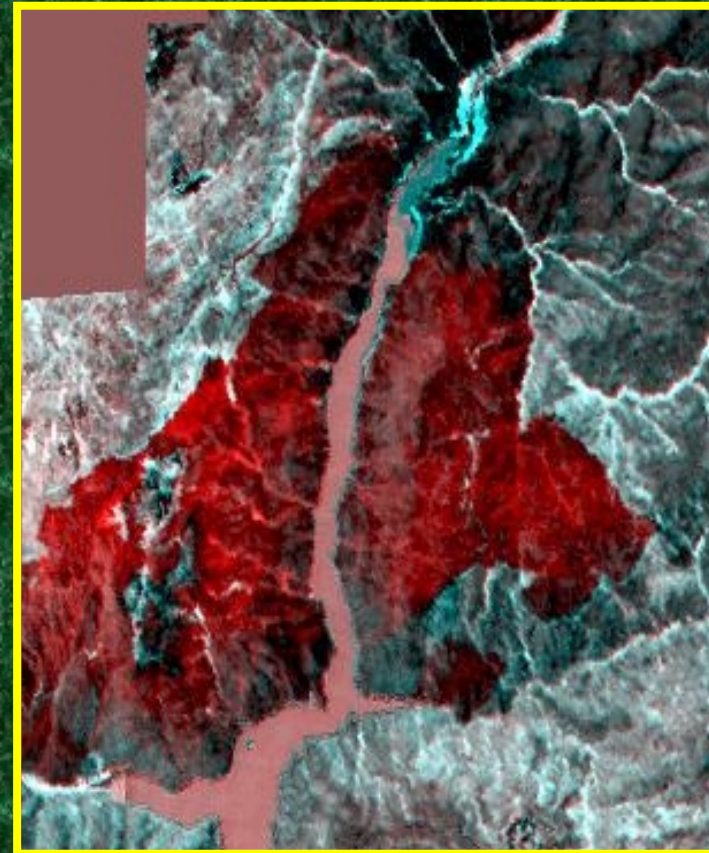
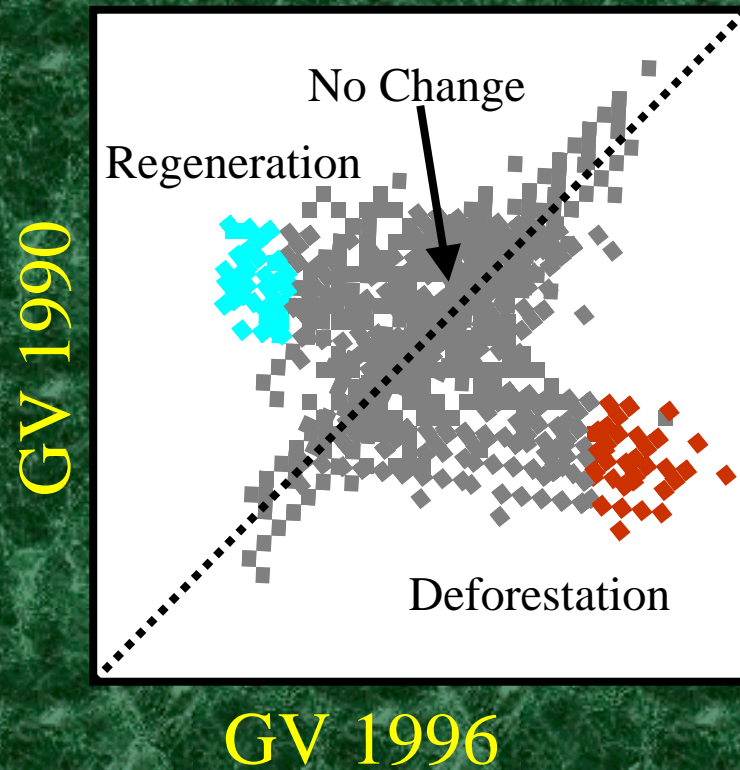
RGB: Soil, GV, NPV





# FRACTION ANALYSIS

## Regrowth and Deforestation



Red = GV 1990

Blue, Green = GV 1996



# Results

## Contingency Matrix: Maximum Likelihood Classification

	REF TOTALS	CLASS TOTALS	CORRECT	PRODUCER'S ACC.	USER'S ACC.	KAPPA
Water Recharge	37	30	26	70.27%	86.67%	0.82
No Change	19	30	20	45.45%	66.67%	0.52
Vegetation Increase	44	30	17	70.83%	56.67%	0.48
Vegetation Decrease	24	30	21	80.77%	70%	0.63
Change in Non- vegetated areas	26	30	14	73.68%	46.67%	0.38
Totals	150	150	98	65%		0.5667



# Results

## Contingency Matrix: Decision Tree Classification

	REF TOTALS	CLASS TOTALS	CORRECT	PRODUCER'S ACC.	USER'S ACC.	KAPPA
Water Recharge	33	30	26	78.79%	86.87%	0.82
No Change	44	30	23	52.27%	76.67%	0.66
Vegetation Increase	27	30	20	74%	66%	0.59
Vegetation Decrease	25	30	23	92%	76.67%	0.72
Change in Non- vegetated areas	21	30	16	76%	53%	0.45
Totals	150	150	108	72%		0.65



# Results and Discussion

- Sources of Error---
  - Spectral confusion- (Topography)
    - Reservoirs: Very Accurate
    - Urban Change: Difficult to adequately characterize using MSMA
    - Veg Decrease: Very Accurate (Fire Scars)
    - Veg Increase: Moderately Accurate-  
Phenological/ Precipitation differences



# Conclusions and Future Work

- Multitemporal Spectral Mixture Analysis
  - Highly accurate in depicting changes in forest cover: Soil, NPV and GV are sensitive to inter-date change in 'natural' cover
- Decision Tree Classifier outperformed a Conventional Maximum Likelihood Classifier by 10% overall and by an average of 9% for each cover change class
- Inclusion of ancillary data sets to reduce spectral confusion and texture images to enhance accuracy